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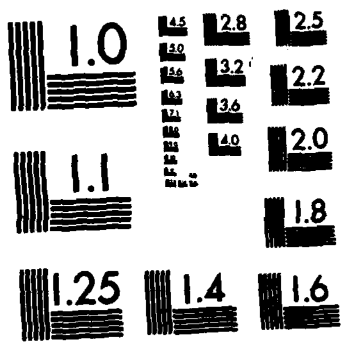

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NATIONAL BUREAU OF STANDARDS-1963-A

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FOREIGN TECHNOLOGY DIVISION

COMMUNICATIONS TODAY

(Selected Articles)

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EDITED TRANSLATION

FTD-ID(RS)T-1750-82 14 January 1983

MICROFICHE NR: FTD-83-C-000050

COMMUNICATIONS TODAY (Selected Articles)

English pages: 14

Source: Xiandai Jongxin, Nr. 8, 1982, pp. 1-4

Country of origin: China
Translated by: LEO KANNER ASSOCIATES
F33657-81-D-0264
Requester: FTD/TQCS
Approved for public release; distribution unlimited.

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COMPUTERS MODERNIZING COMMUNICATIONS SYSTEMS

Lao Chengxin

The terminal is connected with the computer network and a command is input through the keyboard: "Record center: we wish to read news pertaining to China on the 11th of October". After a few seconds five lines are printed out on the printer. Then it asks "which would you like?" The answering command is entered in on the keyboard: "We want number 4". The teletype then prints it out: the complete text of the conversation between the Chinese liason officer in America and the American Secretary of State.

This occured during a fact-finding trip to the United States in October 1973 by Chinese computer scientists. Through terminal facilities of a computer network in the city of Boston in the eastern part of the United States we could read the circumstances of the world in a world international records newspaper run by Stanford University in the western United States and the entire process took less than three minutes.

Advanced technology of this type is the combination of computer technology and communications technology. The basic task of

communications is the exchange and distribution of news. The development and expanded applications of computers has offered some important means for modernizing communications while, on the other hand, methods of utilizing computers have also been revolutionized by modern communications technology. The development of modern communications and electronic computers have been intertwined, each relying on the other and in turn pushed forward by the other.

The accomplishments of the marraige of communications and computers have found an important expression in the computer network.

I. News Distribution, Data Communication, and the Computer Network

The traditional tasks of telecommunications, telephones and telegrams, are communications between people. But when computers enter the realm of communications they produce a data communication system of long range distribution of data and news. This kind of communication is communication between people (or terminals) and computers (that is man-machine) or between computers and computers (that is machine-machine). This has greatly opened up new areas of communications service. However, early data communications used one computer as the center and passed through a wire system to connect with each distant data terminal thus attaining a long distance data management system. Following the development of the "time-sharing management" and "intergroup exchange" computer techniques, the computer network has been developed. It is a system which passes through the data communication network taking multiple computers (these can be computers of the same model or of differing models of large, medium or small computers) and connect them to each other. This not only makes possible treatment of distant news, but can also share the resources of the system (including hardware, software, and data storage).

The computer network has the special features and capabilities which will now be described.

(1) Data transmittal: Computers contained within the network can communicate with each other. As far as using computers, the user can break down geographical limitations and use special distant computers and facilities. Now trans-national or inter-continental computer networks of several thousand kilometers are already established and in use.

(2) Materials sharing. We can fully exploit the computers of the network and their abilities and thus avoid costly redundant facilities for data storage. This is an important capability of the computer network and was an important reason behind the establishment of computer networks. America has one thousand material inquiry systems; in over 160 material storage organizations they store over ten million bits of material. The user who wants to inquire about material need only contact the central computer whereupon he can see on the flourescent screen the material he requires and can also create a copy of the information.

(3) Balance of load: if one computer on the network has work greater than its capacity it can transfer out a section of the job to other points on the network, thus lightening its load. But even more interesting is that it can also exploit the difference in time zones between facilities constructed in different places. For example, under normal conditions computers are very busy during daylight hours, and comparatively less busy at night. Making use of this fact computers in daylight in European countries can use American computers during their night.

(4) High reliability: the reliability of a computer network is much higher than that of any one computer on the system. For example, if a certain computer network has three TQ-16 computers located at places A,B, and C, then when the computer at A has a breakdown then the user at A can use the TQ-16's at B or C on the network.

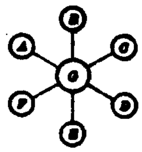


Fig.1 Star form network

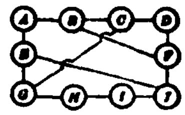


Fig.2 Dispersed form network

There are two basic types of computer network structures.

(1) Star form (Fig.1). When each network point communicates with another network point it must send a signal to the central point G, and then the signal is relayed to the intended computer by the central computer. The star shaped network has one defect: if the central computer goes down the network points cannot work.

(2)The dispersed form network (Fig.2). In the dispersed form network there is no central controlling network point which connects the other network points together. What decides which network point talks to which is distance, the amount of news travelling between the two points, and the suitability of the communications facilities between two points. In this kind of system, there can be more than one route between two points. For example, if the electron source for H fails, G can still go by the route G-E-J-I to communicate with I. If both H and E cannot function, G can use the route G-C-D-F-J-I and still reach I.

The facilities for communication of data in the computer network includes:

(1) Terminals: These are facilities for connecting the output and input into the communications cable system. It works by connecting with a computer to put news into a computer system or take news out of a computer system. Common terminals seen are the printer and keyboard display devices; there is also a type called the smart terminal which has a management device and therefor this machine has

the ability to deal with information itself.

(2) Modem: We all know that long distance transport lines can only transmit electric waves. Because of this, signals which come in from input systems cannot be directly sent through on the transmitting line. The input digital signal must be transformed into an electric wave. In the same way the output electric wave cannot be accepted by the recieving facility, but must be demodulated into a digital signal. An apparatus which has this ability is called a modem.

(3) Multi-route modulator: In the communications area there is one type called the multi-route modulator facility which can transmit from several hundred to several thousand lines on a single transmittal facility. In this way, helped by a multi-route modulator, it is possible to use one communications cable to send communications between many input-output facilities and computers.

II. News Exchange and Sequence Control Electronic Exchange Technology

The expanding uses of computer technology and all types of telegraph exchange machines have realized the saving sequence control. The sequence control electronic exchange machine is not the same as the earlier mechano-electronic machine or the semi-electronic exchange machine. Its control function is not supplied from mechano-electronic or electronic wire arrangement and the logic its sets forth, but rather uses the order sequence table form to put the exchange control function in memory, control the electronic route and carry out control according to this sequence. It can effectively organize an economical, quick, and highly adaptable communication exchange center. When the network is altered or new capabilities are to be added, we only need fix the sequence and input a new sequence and need not correct large amounts of wire arrangement to effect it. This kind of technology has extensive aoplications in local telephone electronic

sequence control exchange machines and teletype systems. For example, the Shanghai Telegraph Bureau uses a DJS-131 machine to make possible an automatic telegraph transmittal machine instead of the former manually operated machine. The time required by the new machine is reduced from 38 minutes to 1.5 minutes while its error is lowered from 0.3% to 0.03% even as the amount of work is raised by ten times. Work production is doubled and the machine saves on oil paper and electricity by 50%. The in-room noise with the old machine reached 82 decibels, the workers load was great, and it was easy to make mistakes. The automatic system is stable and reliable: in over one year of operation there were over 7,000,000 telegraphs sent out without one mistaken transmittal or lost telegraph, and it was economical and effective. At present it is not only international systems but long distance and intr-city systems as well tending to employ saving sequence control systems.

Following the lightening fast development of the electronic computer, especially the appearance of the micro-computer, the applications in the field of communication have been increasing; we can predict that communications enterprises will be one of the largest branches of computer use.

EARTHQUAKE OBSERVATION AND REMOTE MEASUREMENT OF DATA

Chen Huizhong

[Editors Note: At present what scientific techniques are being used by our country to obtain reports about earthquakes? How is remote measurement data of earthquakes transmitted? What earthquakes have occured in the Beijing area? This article answers for you these important questions.]

The measurement of earthquakes from a distance cannot be separated from communication. Therefor the organization which researches earthquake conditions, the National Earthquake Bureau and Geographical Research Institute situated in the west of the capital at Sanlihe is called the Beijing Telecommunications Transmittal Earthquake Station Network Center. The report "Last week's earthquake conditions" in Beijing Science and Technology Bulletin, Vol.1, No.1 is one kind of result of the day and night efforts of the center. It employs communication sciences technology to not only keenly reflect the Beijing area earthquake condition, but also to observe the earthquake conditions of the entire country and the whole world, offering continuously important earthquake news for the country and the people. According to record, in the whole of 1981 there were 238 earthquakes greater than grade one with the largest at 4.7. From looking at the frequency, intensity, and distributive circumstances of the earthquakes we can see that there were no obvious abnormalities and it was a normal yearly amount of earthquake activity.

How does the earthquake station network research the earthquake conditions? We might as well explain the process using a big explosion.

Late at night on a certain day in August, 1981, everyone was already asleep, but the lights were still shining at the Beijing Telecommunications Transmittal earthquake station network as the engineers and technicians were concentrating all their attention on holding fast on the network surveillance platform.

It is an automatic earthquake station network; its earthquake measurement station has no one manning it, and all the earthquake information from every observation station passes through the remote measurement facilities and telegraph line to be relayed to the station network center.

On that night the data the workers were preparing to research was not natural earthquake data, but rather was the data produced by a man-made explosion in the middle of the Bohai Bay. The recording and arranging of this set of complete material is invaluable for determining the underground structure of the North China area.

The green flourescent tubes of the digital clock were reading 23:56, only four minutes away from the set explosion time. The last red light had gone out and communication from the network was unimpeded. The digital clock showed 00:00:00; the recording brushes of the earthquake recording device began to move, one after the other according to the order in which the shock waves reached each of the measuring stations, and scratched out the earthquake wave shape of the remote measurement signal produced by the explosion.

Remote measurement technology is one of the important results of modern science and technology development. The remote measurement methods are different and the signal conveyance methods are different as well. For example air measurement in which many points recieve from one producing point, or satellite remote measurement in which measurement data is sent back from satellites to be recieved by a cerain number of ground stations. This kind of remote measurement data employs radio transmission and uses a fairly wide frequency band. And earthquake data remote measurement employs also the ground to ground method, where many points issue and one central point receives and concentrates the signals. Radio remote measurement distances are influenced by the curvature of the earth, therefor ground to ground remote measurement often employs existing telecommunications networks to relay signals. The frequency width of the internationally used telephone cables is 300-3400 Hertz. This band width can be continuous as desired in the public telegraph network routes, its convergence path can reach from several thousand kilometers up to even 10,000 kilometers. In order to make the information of remote measurement transmittable over the telegraph lines we

need to convert it into an electric signal suitable for transmission. this kind of application of new technology combines collecting material information remote measurement technology and telegraphic network transmission technology and is called telegraph remote transmission technology. At present it is already in extensive use in domestic and international earthquake detection, information gathering on meteriological phenomenon, biology and other areas.

How Telecommunications Relays Earthquake Remote Measurement Data

Most of earthquake data is slow changing super-low frequency. The data of this type collected by each earthquake measurement platform necessitates extraordinary speed of transmittal to the platform network center, performs synthetic analysis, and then finally the shock level and precise center of the earthquake can be measured. In order to exploit the existing telephone and electric lines to transmit earthquake data we generally use the analog modulation method, that is the wave carrying method. Its multi-capacity transmitting system is called the frequency separation multi-route measurement system. Some use on string of digits to pulse to transmit the signal, then immediately picks out the type of signal, quantifies and encodes it, and after that turns it into a digital signal and sends it into the wire. This kind of pattern is called the digital method. Its multi-capacity transmittal method is called the time division multi-route remote measurement method.

So-called frequency multi-route remote measurement takes the frequency modulation percentage of the data and arranges it into a mutually non-interfering frequency ratio, just like a highway divides into several smaller roads. At the present the frequency modulation multi-path earthquake remote measurement facility we use generally employs a telephone cable frequency band which can ordinarily send out twin directional telephone signals divided into eight routes, each frequency band having a width 0.2 Hertz to 20 Hertz, with the eight

central frequency ratios at 540, 900, 1260, 1620, 1980, 2360, 2700, and 3060 Hertz. The frequency modulation bias is f_o*100 Hertz and the modulation indicating number is 5. For the principles of the frequency modulation multi-route remote measurement facility see Fig.1.

The earthquake sensing machine is a revolving tremor locating machine, built looking something like a loudspeaker from inside a radio. When the earth moves, the revolving line on the magnetic field wavers. The electric movement power to which it responds is extremely weak. The electric movement power is in exact proportion to the speed of the wavering movement. Before the ultra-low frequency, a volume increasing machine is placed which moves the output voltage and wavering movement in exact proportion. Afterwards it enters the modulator and is frequency modulated, moving the earthquake signal into the range of sound frequency, it passes through a group of amplifying machines where it is amplified, then passes through an obstructing-matching device which gives it to the telephone line. It is transmitted over the telephone line, and before the recieving point the recieved signal is passed through another group of amplifiers, is amplified, and passes through a wave filtration device where it is wave filtered. Then it is sent into the frequency inspecting device where it is demodulated and its work rate is amplified; it goes quickly to the brush earthquake recording machine to move the brush and record the earthquake signal.

The so-called time separating multi-route remote measurement sends each route of data circulating according to the time sequence successively and makes it mutually non-interfering. It is a kind of communications technique just like the frequency multi-route, and can greatly raise the multiple use effectiveness of communications wire systems. For the principles of the digital earthquake remote measurement facility see Fig.2

The earthquake data that the earthquake sensing machine picks up goes through the preamplifier, and then type selecting and quantifying are performed. In order to expand the range of the developments, encoding is also performed for the increase of each type during the quantifying process. The quantified code and increase code are sent together into the digit conveying machine and are transmitted through the telephone electric lines. At the recieving point the digit conveying machine returns the digital signal to the original, again performs the multi-route division, sends it to the computer for handling, or transforms it in the digital analog changing the digital signal to an analog signal and records it. Compared to the frequency modulation multi-route earthquake remote measurement set up the digital earthquake remote measurement apparatus is strongly anti-jamming, has a large increase range, but must be handled by a computer.

The Organization of the Beijing Telecommunications Transmittal Earthquake Station Network

Using communications electric lines as links, tens of earthquake stations are connected to a center thus creating the telecommunications transmittal earthquake station network. Presently the Beijing Telecommunications Transmittal Earthquake Station Network is organized out of many tens of unmanned observation stations surrounding the Beijing area which pass through long distance telephone cables to function as transmittal lines and concentrate earthquake information at the Beijing center. For the principle of the Beijing Telecommunications Transmittal Earthquake Station Network see Fig.3.

We are told: the earth is formed out of matter, matter moves in the never-resting earth, and in the constantly changing river of history the world can be revealed. The movements of the globe are no different. Earthquake reports are a kind of news record and report concerning the constant movement of the shell of the earth. When each earthquake happens, the waves produced by it are quickly

propagated in the shell of the earth. The vertical wave speed of the earthquake wave is about six kilometers per second. From the dispersal of earthquake observation stations at different places, no matter where the earthquake wave is recieved from it will have early and late stations, weak and strong stations, like the set positions of radio, through manual or computer measurement we can detect the time and position and depth of an earthquake occurance. It is precisely by applying this kind of reasoning that the Beijing Telecommunications Transmittal Earthquake Station Network works day and night to record earthquake data (including natural earthquake data, man-made explosions, mine cave-ins and other such data), earth magnetic field change data, and global pulsation data to serve the people. Even if they are small quakes that cannot normally be felt they will be recorded and used to research the laws of earthquake activity and characteristics off all kinds of changes inside the earth, functioning as the valuable material for probing the prediction of earthquakes nad preliminary measurement. Figure 4 is a partial record chart of a 2.5 level earthquake at Lutai on October 17, 1981.

In the past, before the Beijing Telecommunications Transmittal Earthquake Measuring Station Network was set up, the data collected at each earthquake station was relayed over ordinary telephone or telegraph and required at least one to two hours to concentrate and collect. Determining the earthquake reference numbers took even longer. Now, as the Beijing Telecommunications Transmittal Earthquake Station Network is equipped with communication lines and computers, after the data of an earthquake is obtained, it takes less than ten minutes to get out the earthquake report.

According to the measurings of the Station Network Center, there have been more than 20 earthquakes of level 3.5 or greater that have happened in the Beijing area between 1966 and 1973 and hundreds of earthquakes less than magnitude 3.5. For complete information please

see Fig.5. We can roughly see from this figure that important earthquakes occur in the two northwest and northest line structure.

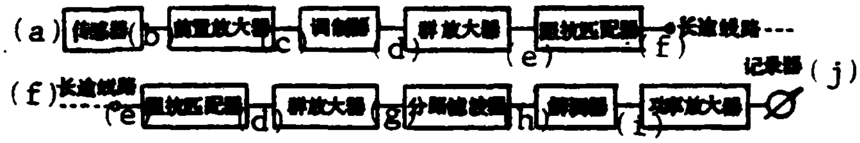


Fig.1

Key: (a) sensing device; (b) pre-amplifier; (c) modulator; (d) amplifier group; (e) obstructing-matching device; (f) long distance line; (g) separate route-wave filtration machine; (h) demodulator; (i) work rate amplifier; (j) record machine.

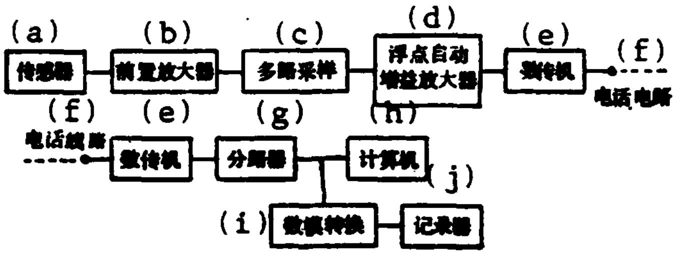
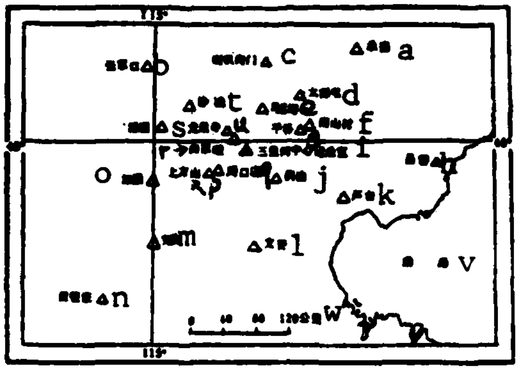


Fig.2

Key: (a) sensing device; (b) pre-amplifier; (c) multi-route type select; (d) floating point automatic increase amplifier;
(e) digit conveyance machine;
(f) telephone-electric line;
(g) route separator; (h) computer;
(i) digital-analog transfomer;
(j) recording machine.

1. Reciever for station network remote earthquake measurements.
2. Observation device for global pulsation records.
3. Earthquake recording machine.



Distribution of the Beijing Telecommunications Transmittal Earthquake Station Network Stations.

Fig.3

Key: (a) Chengde; (b) Zhangjia; (c) Labagoumen; (d) Taishidun; (e) Madauyu; (f) Nanshancun; (g) Pingyu; (h) Changze; (i) Sanlihe central recording room; (j) tongbai; (k) Litai; (l) Wen'an; (m) Wanxian; (n) Huangbiya; (o) Laiyuan; (p) Shangfangshan; (q) Zhoukoudian; (r) Baijiazhong; (s) Suilu [illegible]; (t) Shacheng; (u) Longxiansi; (v) Bohai Bay; (w) kilometers.

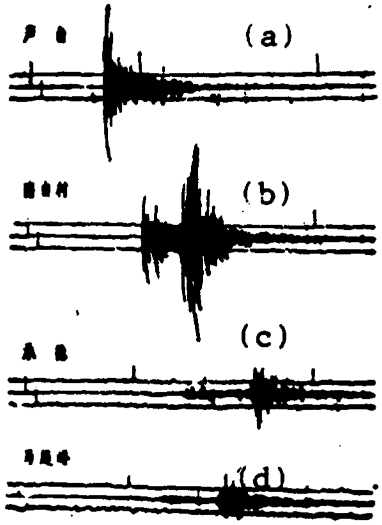
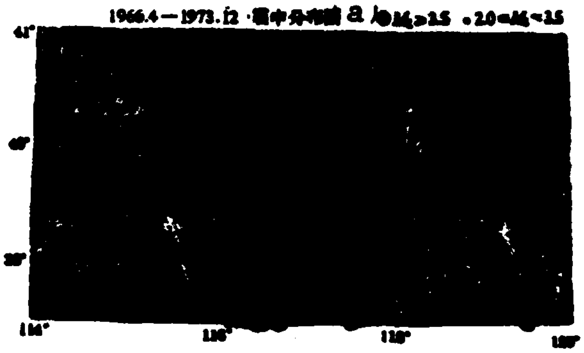


Fig.4

Key: (a) Litai; (b) Nanshancun; (c) Chengde; (d) Madauyu.



Earthquakes in the Beijing area (Station measurements 1966-1973)

Fig.5

Key: (a) Earthquake center distribution chart.

END